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AT-B- 258 067
DD-A- 40 427
DE-C- 887 717
US-A- 2 692 237

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Description

The present invention relates to a delivery controlling device for variable delivery piston pumps provided with a driving shaft bearing a cam for the operation of the pistons.

A plurality of types of variable delivery displacement pumps are known to the state of the art, which are provided with various devices for modifying the delivery.

For agricultural use, particularly for the metering of agricultural auxiliary liquid substances, such as pesticides, insecticides and products for the treatment of plants and crops, metering pumps are used for metering and feeding a liquid to a nozzle apparatus and for transferring the liquid from a container to the tank of the agricultural machine. Such metering pumps are generally provided with a cam and double acting plunger and are operated by a power output syncronized with the speed gear of the agricultural machine.

These pumps must have a variable delivery to fit the various types of liquid to be treated. It has not been possible so far to realize a variable delivery pump for this function, such as to be particularly simple and precise in adjusting its output, and at the same time as free as possible from vibrations and mechanical failures.

US-A-2592237 describes a device in which a driving shaft operates an inner excentric integral thereto and an outer excentric slidingly and pivotally engaged with the inner excentric and with the piston, the overall excentricity being the sum of the excentricities of the excentrics. By turning a wheel of a delivery control device, the overall excentricity can be controlled by modifying the relationship of the two excentrics through a gear system, to vary the pump displacement.

The present invention provides a device in which the entire delivery control device is coaxial to the axis of rotation of the shaft, so as to avoid undesired asimmetrical and unbalanced elements which always involve an undesired stress on the parts of the machine, as well as vibrations and similar drawbacks.

This result is obtained by a structure having a reduced number of pieces which reduces its cost.

Furthermore, the arrangement of the present invention is such that the transition from the minimum to the maximum delivery is graduated through a full turn of a control wheel, so that a more precise set of the pump delivery is obtained.

According to the present invention the device for controlling the delivery of a variable delivery piston pump, comprises a driving shaft rotating about an axis of rotation A, which can be engaged with the power output of a motor and a cam 16 controlling the reciprocating motion of a piston, in which said driving shaft comprises a first shaft member 1 coaxial to the axis of rotation A and a second shaft member integral with said first shaft member consisting of a first 3 and a second 4 shaft portion, the first portion 3 having a geometrical axis E excentric to the axis of rotation A by a fixed excentricity and a second portion 4 being coaxial and aligned to said axis of rotation A and a delivery adjusting unit 15 including said cam 16 slidingly engaged with said piston element of the pump and engaged through gear means to a delivery controlling unit 6, said cam 16 being pivotally mounted on said first excentric portion 3 of the second shaft member and having a geometrical axis C offset with respect to the excentric geometrical axis E of said first portion 3 of the second shaft member, and said delivery controlling unit 6 comprising a wheel 7 and a pinion gear 8 integral therewith, both coaxial to said axis of rotation A of the driving shaft, characterized in that: said first excentric portion 3 and said second portion 4 are in a longitudinally continuous integral relationship along said excentric axis E; a cavity 5 coaxial to the axis of rotation A is provided within said second portion 4; said delivery controlling unit is slidingly mounted within said cavity 5 in said second portion 4; said cam 16 being integral with a cap 17 having an internal toothing coaxial to said excentric axis E of the second shaft portion and being engaged with said pinion gear 8.

An embodiment of the present invention will be described hereinafter in greater detail, with reference to the accompanying drawings, wherein:

- figure 1 is a view, partially in axial cross-section, of the pump according to the invention, conventional elements of the pump being omitted for the sake of simplicity;
- figure 2 shows the arrangement of the pump with the maximum effective excentricity; and
- figure 3 shows the arrangement of the pump with an effective excentricity lower than the maximum one.

Referring to figure 1, it is assumed that the variable delivery pump is a pump of a type with plungers (not shown in the drawings).

The structure of the pump comprises a driving shaft rotating about an axis of rotation A, this shaft being formed with a first member 1 coaxial to the axis of rotation A and mounted by supporting bearings 2, and a second shaft member comprising a first shaft portion indicated in- 3 which is geometrically symmetrical with respect to an excentric geometric axis indicated in E, and a second shaft portion indicated in 4, which is coaxial or centered to- the axis of rotation A and which is integral with said first portion 3. The entire shaft as described, formed by the first member 1 and the second

member 3, 4 rotates about the axis of rotation A, being driven by a power output of the motor (not shown).

In the second portion 4 of the second shaft member an axial cavity 5 is provided to receive a delivery controlling unit, generically indicated in 6, which is formed substantially with a wheel 7 and a pinion gear 8 integral with the wheel 7, through a spindle 9 housed in said axial cavity 5. The unit 6 can slide in an axial direction, guided by the axial cavity 5 and a guide cylinder 11 integral with the unit 6, and it is returned to the operating position (which will be described hereinafter) by a return spring 10 abutting between the guide cylinder 11 and a plate 12 integral with the second portion 4 of the second shaft member and fixed thereto by means of screws 13. In addition to axially sliding, as described herein before, with respect to the second shaft portion 4, the delivery controlling unit 6 can also rotate within the axial cavity 5 about the axis of rotation A, in order to control the adjustment of delivery, as will be described hereinafter. Normally, during the operation of the pump, the unit 6 will be locked to the second shaft portion 4 by means of a locking pin 14 which makes the wheel 7 and the plate 12 rigidly connected. In the locking position the unit 6 will rotate the entire pump shaft as a single unit, in a position axially centered with respect to the axis of rotation. This feature is peculiar to the present invention.

A delivery adjusting unit is generically indicated with numeral 15 and comprises a cam 16 and an annular gear cap 17. The cam 16 is pivotally mounted around the excentrical shaft portion 3 and has a geometric axis indicated with C, which will be hereinafter denominated offset axis. The annular gear cap 17 is integral with the cam 16, however its geometric axis, which is also its axis of rotation, coincides with the excentric geometric axis E of the excentric shaft portion 3. The annular gear cap 17 is provided with an internal toothing in gear with the external toothing of the pinion 8. An adjustment shim 18 separates the unit 15 from the first shaft member 1.

It will be appreciated that the unit 15, as assembled, will rotate about the axis of rotation A during the operation of the pump, so that the cam 16 is the excentric controlling the movable elements (pistons) of the pump, which are schematically indicated in 19, as a reciprocating box of the reciprocating unit for the movement of the pistons, not shown in the drawings.

Referring to figure 1, it should be noted that upon rotation of the wheel 7, previously unlocked from the plate 12 by means of a backward axial sliding movement, the rotation of the pinion gear 8 will drive into rotation the annular gear cap 17 and consequently the cam 16 about the excentric geometric axis E. This movement permits the modification of the effective excentricity of the pump, i.e. the excentricity controlling the volume delivery of the pump itself. The arrangement is more clearly illustrated in figures 2 and 3, which are enlarged schematic representations, substantially in a transversal cross-section through the cam 19, as indicated with the line II-II in figure 1. In figure 2 the first portion 3 of the second shaft member, the cam 16, the reciprocating box 19, as well as the reciprocating unit 20 and a pair of opposed pistons, 21, 22 are shown.

In the illustrated embodiment it has been assumed, for the sake of simplicity, that the offset spacing of the offset axis C to the excentric axis E be equal to the excentricity of said excentric axis E with respect to the axis of rotation A. This arrangement, however, which shows the only advantage of having a nil delivery position, is not essential to the effect of the invention. Under this assumption, it will be appreciated in figure 2, that the offset axis C is in the center of the cam 16 and the cam 16 rotates about the axis of rotation A being integral with the excentric shaft portion 3 in operation, as a consequence of the engagement by the pin 14 of the wheel 7 with the plate 12. In this situation, the effective excentricity of the pump will be the distance from A to C, whereas the fixed excentricity of the shaft portion 3 (point E) is exactly one half of that. Consequently the path of the point C around the point A will describe a circle, indicated with T1 and drawn with a dot-and-dash line. It should be noted particularly that the oscillation range of the reciprocating unit 20 and pistons 21, 22 integral therewith, is equal to the diameter of the circle T1.

Upon varying the effective excentricity of the pump by operating as hereinbefore described, namely by rotating the wheel 7 and making the offset axis C rotate around the excentric axis A, the distance from said offset axis C to the axis of rotation A will be varied, as can be seen in figure 3. In this figure it should be observed that point C has been made to rotate around point E by about 45° clockwise. It can be seen that the distance between the points C and A has decreased and on continuing the rotation of the cam 16 about the shaft portion 3, it should be observed that point C, following a rotation by 180°, is able to coincide with point A. With this it is evident that the total excentricity of the pump will be nil.

In the arrangement of figure 3, once the relationship of the cam 16 and excentric shaft portion 3 is locked, on operation of the pump, the path of the axis C around the axis A will describe a circle indicated with T2. It is easily observed that the diameter of this circle is smaller than the circle T1 in figure 2. This means that the effective excentricity of the pump is decreased. It is evident that,

in the case of the offset spacing between C and A being different from the fixed excentricity defined by the distance E-A, the effective excentricity will vary from a maximum to a minimum other than zero.

In any case the variation from the maximum to the minimum excentricity is obtained by a 180° rotation of the cam 16 about the excentric shaft portion 3. It should be appreciated that when choosing a transmission ratio of 1:2 between the pinion gear 8 and the annular gear cap 17, this 180° rotation will correspond to a 360° rotation of the wheel 7. This makes it possible to obtain a fine and precise adjustment of the excentricity and consequently of the delivery by the pump or pumps. Advantageously for the delivery adjustment, the wheel 7 will be provided with a mark related to an indexed scale on the plate 12 calibrated in function of the pump delivery. The arrangement of the indexes can obviously be inverted.

The pump according to the present invention is particularly suitable for the metering in agriculture of substances which are to be injected into the soil in precise doses and it shows the advantage of an extremely simple handling to obtain an extremely precise effect.

Claims

1. Device for controlling the delivery of a variable delivery piston pump, comprising a driving shaft rotating about an axis of rotation (A) which can be engaged with the power output of a motor, and a cam (16) controlling the reciprocating motion of a piston, in which said driving shaft comprises a first shaft member (1) coaxial to the axis of rotation (A) and a second shaft member integral with said first shaft member consisting of a first (3) and a second (4) shaft portion, the first portion (3) having a geometrical axis (E) excentric to the axis of rotation (A) by a fixed excentricity and a second portion (4) being coaxial and aligned to said axis of rotation (A) and a delivery adjusting unit (15) including said cam (16) slidingly engaged with said piston element of the pump and engaged through gear means to a delivery controlling unit (6), said cam (16) being pivotally mounted on said first excentric portion (3) of the second shaft member and having a geometrical axis (C) offset with respect to the excentric geometrical axis (E) of said first portion (3) of the second shaft member, and said delivery controlling unit (6) comprising a wheel (7) and a pinion gear (8) integral therewith, both coaxial to said axis of rotation (A) of the driving shaft

   characterized in that:

   said first excentric portion (3) and said second portion (4) are in a longitudinally continuous integral relationship along said excentric axis (E);

   a cavity (5) coaxial to the axis of rotation (A) is provided within said second portion (4);

   said delivery controlling unit (6) is slidingly mounted within said cavity (5) in said second portion (4);

   said cam (16) being integral with a cap (17) having an internal toothing coaxial to said excentric axis (E) of the second shaft portion and being engaged with said pinion gear (8).

2. Device according to claim 1, in which a plate (12) secured to said second portion (4) of the second shaft member closes said cavity 5 and is provided with a central bore, and said delivery control unit comprises a spindle (9) integral with said wheel (7) and said pinion gear (8), said spindle passing through said bore in the plate (12) and having a cylindric guide (11) sliding in contact with said cavity (5).

3. Device according to claim 1, in which the transmission ratio of the gear cap (17) and the pinion gear 8) is 1:2, whereby a 360° rotation of the wheel (7) drives said cam into a 180° rotation, so varying the effective excentricity of the pump from a minimum to a maximum in a full turn of the wheel.

4. Device according to claim 1, in which said delivery controlling unit (6) is normally locked to the second portion (4) of the second shaft member by means of a pin (14) and it can be unlocked to modify the delivery, by making said controlling unit (6) axially sliding within said coaxial cavity (5) of the second shaft portion, under the action of a return spring (10).

5. Device according to any of the preceding claims, in which the offset geometrical axis (C) of said cam (16) has an offset spacing equal to the fixed excentricity of said excentric geometric ais (E) of the first portion (3) of the second shaft member, so that the effective excentricity of the pump can vary from 0 to twice said fixed excentricity.

6. Device according to any of the preceding claims, in which said wheel is provided with a fixed mark and said plate is provided with an indexed scale calibrated to the pump delivery.

Revendications

1. Dispositif pour contrôler le refoulement d'une pompe à piston à débit variable comprenant un arbre moteur tournant autour d'un axe de rotation (A) qui peut être engagé avec l'arbre d'entrainement d'un moteur, et une came (16) qui contrôle le mouvement alternatif d'un piston, où ledit arbre d'entrainement comprend un premier élément d'arbre (1) coaxial par rapport à l'axe de rotation (A) et un second élément d'arbre solidaire avec le premier élément d'arbre, qui est formé d'une première (3) et d'une seconde (4) partie d'arbre, la première partie ayant un axe géométrique (E) excentrique par rapport à l'axe de rotation (A) d'une excentricité fixe et la seconde partie (4) étant coaxiale et alignée par rapport audit arbre de rotation (A) et un groupe de réglage de débit (15) qui comprend ladite came (16) engagé en coulissement avec ledit élément à piston de la pompe et engagé par des moyens à engrenage avec un groupe de contrôle de débit (6), ladite came (16) étant montée en rotation sur ladite première partie excentrique (3) du second élément d'arbre et ayant un axe géométrique (c) décalé par rapport à l'axe géométrique excentrique (E) de ladite première partie (3) du second élément d'arbre, et ledit groupe de contrôle de débit (6) comprenant un volant (7) et un pignon (8) solidaire avec ce dernier, tous les deux étant coaxiaux par rapport audit axe de rotation (A) de l'arbre d'entrainement,

   caractérisé en ce que:

   ladite partie excentrique (3) et ladite seconde partie (4) sont solidaires entre elles et continues en sens longitudinal le long dudit axe excentrique (E); une cavité coaxiale par rapport à l'axe de rotation (A) est formée à l'intérieur de ladite seconde partie (4); ledit groupe de contrôle de débit (6) est monté en coulissement dans la cavité (5) de ladite seconde partie (4);

   ladite came (16) étant solidaire avec une coupelle (17) pourvue d'un engrenage intérieur coaxial par rapport audit axe excentrique (E) de la seconde partie d'arbre et étant engagée avec ledit pignon (8).

2. Dispositif selon la revendication 1, où une plaque (12) fixée à ladite seconde partie (4) du second élément d'arbre ferme ladite cavité (5) et est pourvue d'un trou central, et ledit groupe de contrôle de débit comprend une broche (9) solidaire avec ledit volant (7) et ledit pignon (8), la broche passant à travers le trou de la plaque (12) et ayant un guide cylindrique (11) coulissant en contact avec ladite cavité (5).

3. Dispositif selon la revendication 1, où le rapport de transmission du capuchon à engrenage (17) et le pignon (8) est 1:2, de façon à ce qu'une rotation de 360° du volant (7) entraîne une rotation de 180° de ladite came, de manière à changer l'excentricité effective de la pompe d'un minimum à un maximum pendant un tour complet du volant.

4. Dispositif selon la revendication 1, où ledit groupe de contrôle de débit (6) est normalement bloqué à la seconde partie (4) du second élément d'arbre au moyen d'une épingle (14) et peut être débloqué pour changer de débit en faisant coulisser axiellement ledit groupe de contrôle (6) dans ladite cavité axiale (5) de la seconde partie d'arbre, sous l'action d'un ressort de réaction (10).

5. Dispositif selon l'une quelconque des revendications précédentes, où l'axe géométrique décalé (C) de la came (16) possède une distance de décalage égale à l'excentricité fixe dudit axe géométrique excentrique (E) de la première partie (3) du second élément d'arbre, de façon à ce que l'excentricité effective de la pompe puisse varier de 0 au double de l'excentricité fixe.

6. Dispositif selon l'une quelconque des précédentes revendications, où ledit volant est pourvu d'un repère fixe et ladite plaque est pourvue d'une échelle graduée calibrée au débit de la pompe.

Patentansprüche

1. Vorrichtung zur Steuerung der Förderung einer Pumpe mit veränderlicher Förderung, bestehend aus einer drehbaren Antriebswelle, die mit dem Getriebe eines Motors verbunden werden kann und sich um eine Drehachse (A) dreht, und einer Nocke (16) die die Hin- und Herbewegung eines Kolbens steuert, worin die Antriebswelle einen ersten gegenüber der Drehachse (A) koaxialen Wellenteil (1) und einen zweiten mit dem ersten Wellenteil integralen Wellenteil hat, wobei dieser aus einem ersten (3) und einem zweiten (4) Abschnitt besteht, wobei der erste Abschnitt (3) eine exzentrische geometrische Achse (E), mit festgesetzter Exzentrizität gegenüber der Drehachse (A) hat, und der zweite Abschnitt (4) der Drehachse (A) gegenüber koaxial eingefügt ist, und aus einer Einheit für die Regelung der Förderung (15) in der die Nocke (16) mit dem Kolben der Pumpe gleitend verbunden ist und durch ein Getriebe mit der Einheit zur Steue-

rung der Förderung (6) in Verbindung steht, wobei die Nocke (16) drehbar auf dem ersten exzentrischen Abschnitt (3) des zweiten Wellenteils angebracht ist und eine der exzentrischen geometrischen Achse (E) des ersten Abschnitts (3) des zweiten Wellenteils gegenüber versetzte geometrische Drehachse (C) hat, und die Einheit zur Steuerung der Förderung (6) mit einem Handrad (7) und einem damit integralen Ritzel (8) versehen ist, die beide der Drehachse (A) der Antriebswelle gegenüber koaxial sind, und dadurch gekennzeichnet ist, dass:

der erste exzentrische Abschnitt (3) und der zweite Abschnitt (4) entlang der exzentrischen Achse (E) in Längsrichtung durchgehend integral sind;

eine Vertiefung (5) im zweiten Abschnitt (4), der Drehachse (A) gegenüber koaxial angebracht ist;

die Einheit zur Steuerung der Förderung (6) innerhalb der Vertiefung (5) im zweiten Abschnitt (4) gleitend angebracht ist;

die Nocke (16) mit einer Glocke (17) integral ist, die eine, der exzentrischen Achse (E) des zweiten Wellenabschnitts gegenüber koaxiale Innenverzahnung aufweist und mit dem Ritzel (8) verbunden ist.

2. Vorrichtung nach Anspruch 1, worin eine Platte (12), die mit dem zweiten Abschnitt (4) des zweiten Wellenteils verbunden ist, die Vertiefung (5) verschliesst und eine zentrale Bohrung aufweist, die Einheit zur Steuerung der Förderung im weiteren aus einer mit dem Handrad (7) und dem Ritzel (8) integralen Spindel (9) besteht, die durch die Bohrung in der Platte (12) läuft und eine zylindrische Leitvorrichtung (11) in gleitendem Kontakt mit der Bohrung (5) hat.

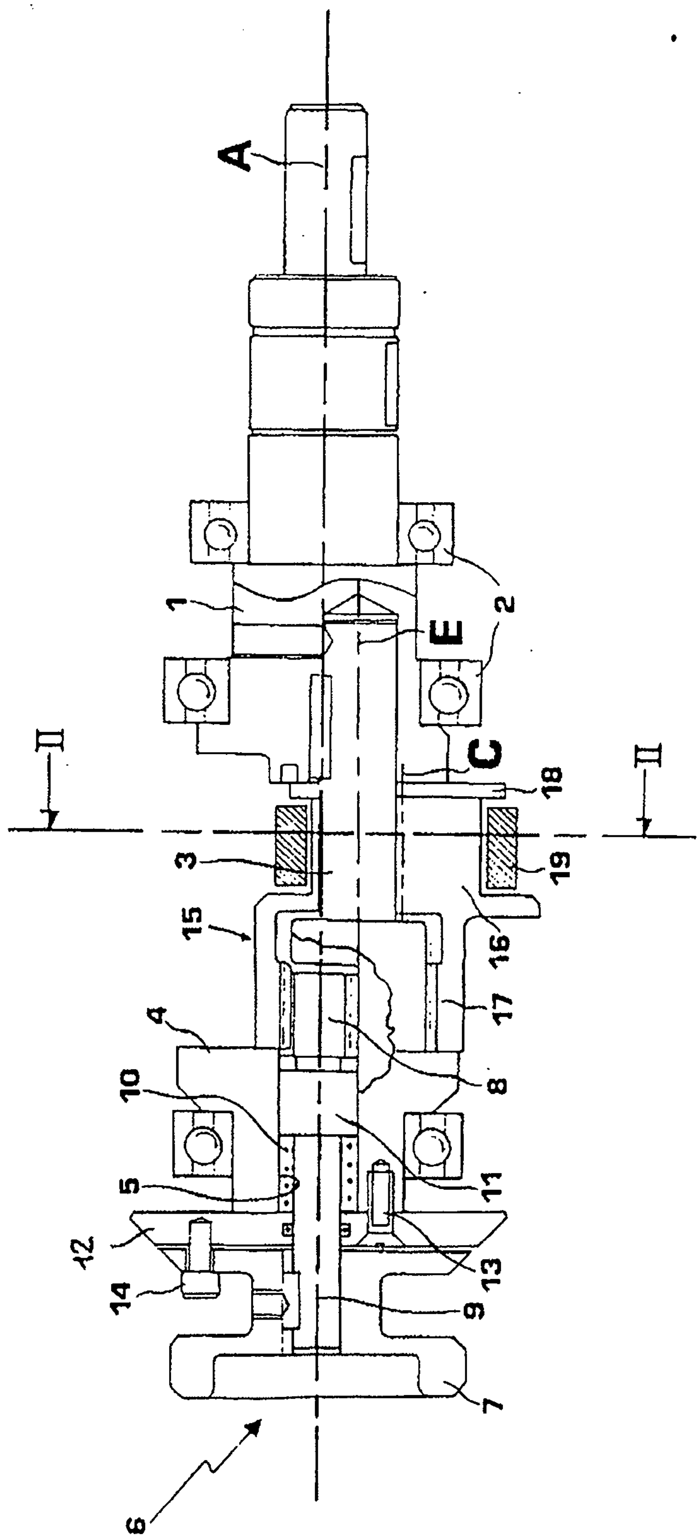
3. Vorrichtung nach Anspruch 1, worin das Übersetzungsverhältniss der Glocke (17) und des Ritzels (8) 1:2 ist, wobei eine Drehung des Handrades (7) um 360°, die Nocke in eine 180° Rotierung bringt, und auf diese Weise die effektive Exzentrizität der Pumpe in einer ganzen Drehung des Rades von einem Mindestwert auf einen Höchstwert bringt.

4. Vorrichtung nach Anspruch 1, in der die Einheit zur Steuerung der Förderung (6) im Normalzustand, durch einen Bolzen (14) in den zweiten Abschnitt (4) des zweiten Wellenteils eingerastet ist, und zur Veränderung der Förderung ausgerastet werden kann, indem die Steuereinheit (6) durch die Tätigkeit einer Rücksprungfeder (10) axial innerhalb der koaxialen Vertiefung (5) des zweiten Wellenteils läuft.

5. Vorrichtung nach einem der vorhergehenden Ansprüche, in der die versetzte Drehachse (C) der Nocke (16) einen Versetzungsabstand hat, der mit der festgelegten Exzentrizität der geometrischen Achse (E) des ersten Abschnitts (3) des zweiten Wellenteils übereinstimmt, so dass die effektive Exzentrizität der Pumpe von 0 bis zum Doppelten der festgelegten Exzentrizität variieren kann.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, in der das Rad mit einem Zeichen versehen ist und die Platte eine auf die Förderung der Pumpe geeichte Maßskala aufweist.

FIG.1



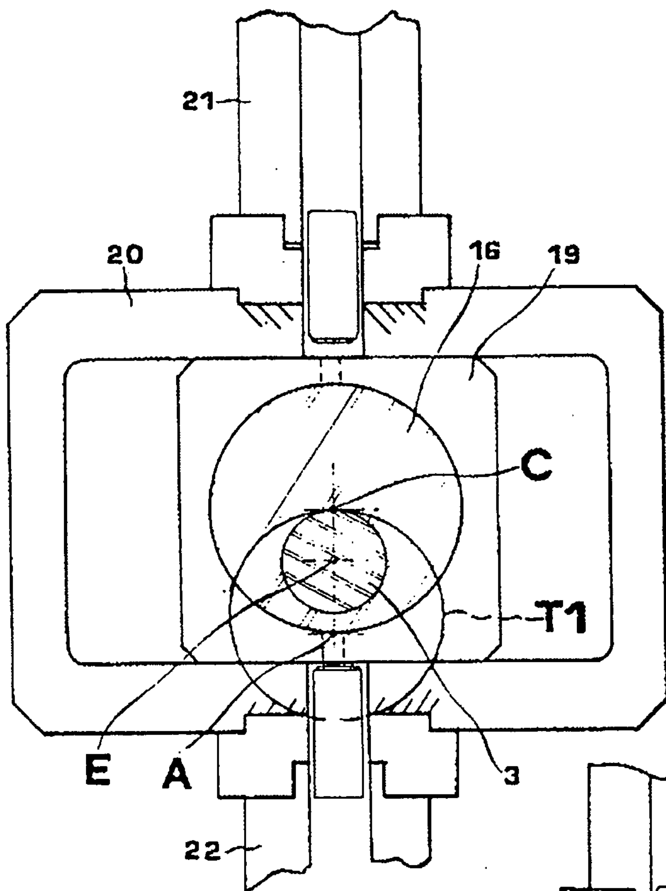


FIG.2

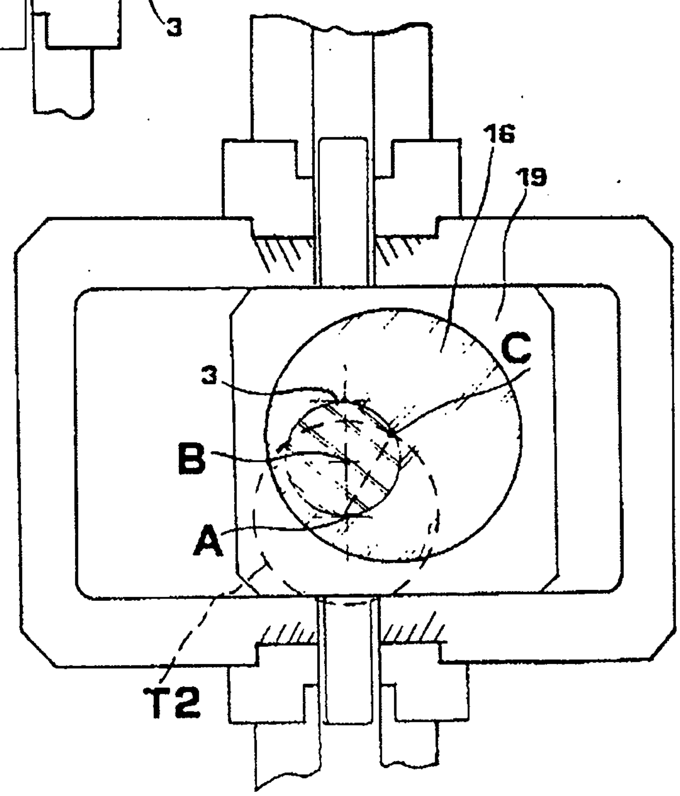


FIG.3